A Novel Use of Human Acellular Dermis for Conduit Salvage After Esophagectomy

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Postesophagectomy anastomotic leaks cause significant morbidity and mortality. Esophageal diversion is often required when extensive tissue loss precludes primary repair. We describe a technique in which human acellular dermis (AlloDerm) is used to repair the conduit, and report a series of 3 patients with significant anastomotic dehiscence whose conduits were salvaged using this technique.

Conduit necrosis or ischemia after esophagectomy can have severe consequences. In such instances, few options remain other than esophageal diversion, with or without delayed reconstruction using an alternative conduit. We report a series of 3 patients in whom human acellular dermis, AlloDerm (LifeCell Corporation, Branchburg, NJ), was successfully used to salvage dehisced conduits after esophagectomy.

Technique

Our approach is through a right thoracotomy, which provides adequate exposure to evaluate and repair the conduit. After debriding all nonviable tissue, the conduit is assessed to determine whether primary closure is feasible. An existing esophageal stent can be left in place (Fig 1A) or removed as required to facilitate repair. If feasible, primary closure is first performed and then reinforced with a patch of thick AlloDerm. The patch is anchored to the surrounding healthy tissues with 3-0 silk (Ethicon, Somerville, NJ) horizontal mattress sutures (Fig 1B). When extensive loss of tissue precludes primary closure, a thick piece of AlloDerm is placed as an onlay patch (Fig 2A) or wrapped around the conduit (Fig 2B), depending on how much the conduit can be mobilized. If wrapped around the graft, the longitudinal edges of the AlloDerm are also sewn to each other with interrupted 3-0 silk sutures (Fig 2B). Multiple chest drains as well as a nasogastric tube are placed.

Patients and Methods

PATIENT 1. A 75-year-old man with stage I (T1b N0 M0) distal esophageal adenocarcinoma underwent a right thoracotomy (Ivor Lewis) esophagectomy after unsuccessful endoscopic mucosal resection. His comorbidities included peripheral vascular disease, coronary artery disease, and a significant smoking history. Three weeks after his surgery, he experienced an anastomotic leak. Endoscopy revealed circumferential ulceration of the anastomosis (Fig 3). After a few days of conservative management with nasogastric and chest tube drainage, he exhibited hemoptysis. A small tear in the right mainstem bronchus was seen on bronchoscopy, and was suspected of being a tracheal-conduit fistula. He failed to progress with esophageal stenting, and an exploratory right thoracotomy was performed. The small (2 to 3 mm) tracheal-conduit fistula was primarily closed and covered with a pericardial fat pad. A larger anastomotic defect identified in the lateral wall could not be primarily reapproximated. After removing the stent, a thick AlloDerm patch was circumferentially wrapped around the anastomosis as described above (Fig 4A). The bronchial repair was intact when tested under saline solution immersion. A nasogastric tube and multiple chest drains were placed. Two days later, the esophageal stent was reinserted to support healing of the tracheal-conduit fistula. During the next 5 months, the fistula was evaluated with interval endoscopies. The stent was removed after the fistula had healed, which was confirmed by an esophagram (Fig 4B). He tolerated an oral diet but required intermittent dilatation for an anastomotic stricture that developed 4 months after stent removal.

PATIENT 2. A 69-year-old man with stage I (T2 N0 M0) distal esophageal adenocarcinoma underwent Ivor Lewis esophagectomy after neoadjuvant chemoradiation. He had a strong smoking history and previous endovascular repair of an abdominal aortic aneurysm. Esophagram after 1 week was negative for leak. Two days later, he experienced severe sepsis secondary to a large anastomotic leak and required intubation. Multiple chest tubes were placed. Bronchoscopy showed a large amount of pus in the right lower lobe, but no obvious fistula. Upper endoscopy revealed near-circumferential necrosis and a large anastomotic defect. Given his surgical history, an
attempt was made to salvage the conduit using an esophageal stent. Owing to a persistent right lung collapse and failure to extubate, an exploratory right thoracotomy was performed.

Intraoperative findings included extensive gastric conduit necrosis with a 5-cm anastomotic defect through which the stent was easily visualized (Fig 5A). Extensive debridement was performed without removing the stent. A thick AlloDerm patch was used to completely cover the defect and anchored with 3-0 silk horizontal mattress sutures (Fig 5B) to healthy areas of the esophagus and stomach. Severe mediastinal inflammation prevented inspection of the medial wall. Intraoperative bronchoscopy showed a small tracheal defect just above the carina. A tracheal stent was not placed because of concerns of pressure necrosis between two stents. A tracheostomy was performed. After a prolonged recovery, the chest drains were eventually removed. Endoscopy (Fig 6A) and esophagram (Fig 6B) showed complete healing of the fistula after 4 months, and the stent was removed. He tolerated an oral diet but required serial endoscopic dilations of a benign anastomotic stricture.

PATIENT 3. A 59-year-old man with stage 1 (T2 N0 M0) distal esophageal adenocarcinoma underwent Ivor Lewis esophagectomy after neoadjuvant chemoradiation. A week later, he experienced severe chest pain and sepsis owing to anastomotic breakdown. A right thoracotomy revealed necrosis of the proximal gastric conduit. Debridement resulted in a 1-cm defect surrounded by a 3-cm-wide area of partial-thickness ischemia but healthy mucosa. As a result of tension, only a single full-thickness layer closure could be performed. A thick AlloDerm patch was wrapped circumferentially around the anastomosis and sutured to the healthy conduit and esophagus using 3-0 silk horizontal mattress sutures. A nasogastric tube and...
multiple chest drains were placed. An esophageal stent was placed 2 days later and removed after 6 weeks. Endoscopy and esophagram showed no leak, but a small pseudodiverticulum where the patch had been placed was observed (Fig 7). An oral diet was started, which he has tolerated well.
Comment

Anastomotic leaks occur in 6% to 14% of esophagectomies [1, 2], leading to mortality rates as high as 35% [3]. Up to 40% of patients with an intrathoracic anastomotic leak may require reoperation, including diversion in more than 4% [4]. Once diverted, restoring esophageal continuity can be difficult [5], with few patients healthy enough to undergo reconstruction.

Our case series suggests that AlloDerm can be effectively used to salvage neoesophageal conduits, even with extensive tissue loss. In 2 of our patients, the extent of necrosis and poor clinical conditions gave us few alternatives to diversion or patching with a viable tissue flap. In the third patient, we performed a single-layer primary closure in the setting of partial-thickness ischemia of the conduit and reinforced it with AlloDerm.

The use of AlloDerm to restore continuity in a gastric conduit has been reported only once before. In that report, an onlay patch of AlloDerm was used to close a 2-mm anastomotic breakdown after laparoscopic-assisted Ivor Lewis esophagectomy, with the patient resuming a full liquid oral diet by the second postoperative week [6]. In 2 other patients, tracheal membrane defects attributable to acquired tracheoesophageal fistulas were repaired using AlloDerm with muscle flap coverage and primary repair of the esophagus [7, 8]. Sinha and associates [9] described pharyngeal reconstruction with AlloDerm and sternocleidomastoid muscle flap after partial pharyngectomy in 14 patients, all of whom eventually resumed a oral diet.

AlloDerm is resistant to infection and serves as a natural scaffold for cellular regeneration by extension from adjacent normal tissue. Unlike native tissue flaps, AlloDerm can be tailored to fit any size of defect. It has been used successfully to patch esophageal leaks in canine laboratory models [10]. Becksted and colleagues [11] demonstrated that rat esophageal epithelial cells seeded on AlloDerm showed superior morphology, resembling native esophagus, when compared with those seeded on synthetic scaffolds. A caveat is that even though epithelialization occurs, esophageal muscle is not restored, which may affect swallowing.

Vascular flaps such as muscle, pericardium, or omentum can theoretically be used to patch a conduit defect, but may not be readily available. Intercostal muscle flaps and pericardial patches can be difficult to harvest when significant inflammation is present. Most patients with significant intrathoracic leaks present in extremis, and prolonging the operative time to harvest native biological flaps may be undesirable. The available length of these flaps may also be limited. Esophageal stenting has been shown to reduce the reoperation rates in smaller thoracic anastomotic dehiscences, but extensive tissue loss may limit the success of stenting. In such cases, buttressing of the defect with native tissue flaps may be a useful adjunct to stenting.

Although the conduit was successfully salvaged with AlloDerm in all the patients described, many questions remain. These include the role of concomitant stenting, timing of oral intake, and the risk of stricture formation. The long-term results are unknown. Despite this, we suggest that reconstruction with AlloDerm can be considered for repair of the dehisced conduit as an alternative option to diversion.

References
